

Variations in the prevalence of spondylolysis in early British populations

H A Waldron PhD MD *St Mary's Hospital, London and Institute of Archaeology, 31-34 Gordon Square, London WC1H 0PY*

Keywords: spondylolysis; palaeopathology; spondylolisthesis; osteoarthritis

Summary

Crude prevalence rates of spondylolysis were estimated in skeletal populations from various periods. There was a steady increase in prevalence from 3.74% in Romano-British to 5.08% in medieval populations, but the rate fell considerably to 1.42% in a population from an 18th/19th century context. This trend was not statistically significant, however. The male/female ratio was approximately unity until the 18th/19th century when the expected male excess appeared.

The lesions predominantly affected L5 and all were isthmic in type. Of the total of 52 cases, only four were unilateral. One occurred in the fourth cervical vertebra. There were few complications; spondylolisthesis was noted in four cases and in three there were osteoarthritic changes on the superior margin of the displaced lamina.

Introduction

Spondylolysis occurs in between 5% and 7% of the modern Caucasian population but shows considerable racial variation¹. Those studies which have looked at the prevalence in skeletal material have generally found rates which are similar to those in clinic patients. Relatively little is known about the changes in prevalence over time in populations from the same region, however, and this is the subject of the present paper.

Material

Skeletons have been examined from a number of sites in southern Britain relating to four time periods, Romano-British, Anglo-Saxon, Medieval and finally, a group from the 18th and 19th centuries. The skeletons from the first three periods came from a number of different sites, but the skeletons from the most recent period were all recovered from the crypt of Christ Church, Spitalfields, in east London. All were examined for the presence of spondylolysis and where it was found, for the additional presence of spondylolisthesis. No case was observed in any sub-adult skeleton and the data are given only for adult skeletons, the total number of which was 1659. Of this total, 214 were Romano-British, 110 Anglo-Saxon, 629 Medieval and 706 18th/19th century.

Results

Prevalence rates

The crude prevalence rates (%), by sex, are shown in Table 1. It will be seen that the rates for the three

Table 1. Crude prevalence rates (%) of spondylolysis, by sex, for different periods

	Male	Female	Total	M/F ratio
Romano-British	3.79	3.66	3.74	1.04
Anglo-Saxon	3.64	5.45	4.55	0.67
Medieval	5.01	5.20	5.08	0.96
18th/19th centuries	2.22	0.58	1.42	2.83

earlier periods are roughly comparable with modern rates but those for the most recent period are lower than might have been expected, in the case of the females, decidedly so. There is some tendency for the rate to increase throughout the first three periods but this trend is abruptly discontinued by the 18th/19th century results. As can be seen from Table 1, the rates are roughly equal between the sexes for the Romano-British and Medieval periods but there is a substantial females excess in the Anglo-Saxon period. It was only in the most recent period that the sex ratio shows the male excess seen in contemporary subjects. In none of the populations was there any evidence that prevalence increased with age.

Site of lesions

All lesions were of the isthmic type (type II in the classification of Wiltse *et al.*²); their site is shown in Table 2. It should be noted that in Table 2 the total number of vertebrae affected is one greater than appears from the data in Table 1; this is because in one skeleton, two vertebrae were affected. In the majority of cases, L5 was affected (45 of 56, 80.4%); in one of the cases it was actually the fifth of the six lumbar vertebrae which were present. This case was a medieval female of 45 years or more at death. A small number of lesions were noted between L2 and

Table 2. Sites of spondylolysis

	Unilateral	Bilateral
C4	0	1
L2	1 (rhs)	0
L3	0	2
L4	0	4
L5	3 (1 lhs, 2 rhs)	45
Total	4	52*

*Includes two from a single case
lhs, lesion on left hand side; rhs, lesion on right hand side

Correspondence to Dr H A Waldron, Department of Occupational Health, St Mary's Hospital, Praed Street, London W2 1NY

0141-0768/91/
090547-03/\$02.00/0
© 1991
The Royal
Society of
Medicine

L4 and one skeleton (a Romano-British female of between 35 and 45 years of age at death) had a lesion at C4.

In four cases the lesions were unilateral, three on the right and one on the left. In the case in which the lesion was unilateral on the left, the left facet joint on the first sacral segment was also hypoplastic. As mentioned above, there was one case, a female of between 25 and 35 years from the Medieval period, in which two vertebrae were affected, L4 and L5.

Associated lesions

Spondylolisthesis was present in four cases, three from the medieval period and one from the 18th/19th centuries. In one of the medieval cases, a large osteophyte had formed on the sacrum and was acting to buttress the slipping lumbar vertebra. There was about 50% slippage in this case. In the case from the 18th/19th centuries, the body of L5 was considerably wedged from front to back and L4 was tilted somewhat backwards. The inferior part of the left facet joint of L4 was in articulation with the superior part of the separated lamina of L5 which was itself flattened and eburnation had developed at the point of articulation. The net result of these changes was that the individual, a male of between 45 and 55 years at death, had lost about 2 cm in height.

An unusual lesion was present in a case from the 18th/19th centuries. This adult female had diffuse idiopathic skeletal hyperostosis (DISH) and the exuberant proliferation of new bone which had been produced in the spine had re-united the fractured neural arch (of L3) back to the body of the vertebra.

Osteoarthritis in association with spondylolysis

There were three cases (two medieval and one 18th/19th century) in which the superior margin of the displaced lamina had come into contact on one side with the vertebra above and developed eburnation. I am not aware that osteoarthritic changes have been noted in this connection before.

Discussion

The prevalence of spondylolysis found in this study is similar to that which has been found in other studies of Caucasian skeletons³⁻⁵. Moreover, the present data confirm that unilateral lesions are rare⁶, as are lesions in the upper lumbar spine⁷ and multiple lesions⁸. One of the lesions occurred at the fourth cervical level and this is distinctly uncommon; when Nordström and his colleagues⁹ reviewed the literature in 1986, for example, they were able to find only 27 cases of spondylolysis in the cervical spine and there have been very few additions to the literature since. One interesting case described by Cox and Aspegren¹⁰, a 65-year-old female, had degenerative spondylolisthesis at the levels of C7 and L4. There is some suggestion that the cervical lesion is familial^{9,11} but the present data clearly cannot add any further information on this point.

Most studies of adult skeletons have been unable to demonstrate any increase in the prevalence of spondylolysis with increasing age. The early study of Willis¹² which appeared to show that the condition was twice as frequent after the age of 50 years was later shown by Rowe and Roche⁴ to be due to a sampling error. Certainly in the present series, there was no significant increase in prevalence with age.

One way in which the results from the present study do not conform to the general rule, however, is by failing to demonstrate a higher prevalence in males than in females except in the most recent group of skeletons which, despite showing the more normal male/female ratio, has a low prevalence. In most populations the condition seems to occur in males at least twice as commonly as in females¹ but there was no significant difference in the rates by sex in the total sample. In the more recent sample, however, the difference does (just) reach statistically significant levels; using Fisher's exact test (because of the low expected values), $P=0.049$. This suggests that the difference in prevalence rates between the sexes may be a rather recent phenomenon.

The principal aim of this study was to determine whether or not the prevalence of spondylolysis had altered over time in populations drawn from a broadly similar geographical area. The rate does appear to increase steadily from the Romano-British to the medieval period but this is almost certainly a chance finding and a χ^2 for trend was not significant. The very low prevalence found in the population from the 18th/19th century context, however, was significantly different from the prevalence in the other three groups taken together ($P<0.001$). Assuming that the prevalence rates are a reasonably accurate reflection of the rates in the living populations, which is likely to be the case¹³ and that the differences in the rates are a real biological phenomenon, and not just a statistical artefact, then some explanation must be found for the much lower rates in the most recent period. If one accepts the traumatic aetiology of the condition, then perhaps some social or environmental factors acted to protect the 18th/19th century group from the injuries which led to fracture of the pedicles. The socio-economic conditions in Spitalfields varied considerably over the 150 or so years covered by the burials but the population was relatively close-knit, including many Huguenots whose principal occupation was weaving. It is possible that the lives of these people was less arduous than those of their predecessors but it is difficult to determine precisely in what ways, and it would be of some interest to amass further data on other groups to see whether a similar trend over time is observed.

There were very few other conditions associated with the spondylolysis; only two of the cases appeared to show spondylolisthesis although as Merbs¹ has pointed out, this condition may be difficult to detect in skeletal material and so it is possible that some cases were undiagnosed. The most interesting association was the finding of eburnation on the superior margin of the displaced lamina in three cases. So far as I am aware, this has not been described before and in any case, would be virtually impossible to demonstrate in the living subject. This demonstrates one of the few advantages which the palaeopathologist has over his clinical colleagues, that is, he is able to examine parts of the skeleton which are virtually inaccessible to anything other than direct observation. Other unusual sites of osteoarthritis have been described elsewhere¹⁴ and demonstrate, albeit in a small way, that palaeopathology may be of value in furthering our understanding of disease. In understanding the anatomy and prevalence of spondylolysis, it has already made several useful contributions.

References

- 1 Merbs CF. Spondylolysis: its nature and anthropological significance. *Int J Anthropology* 1989;4:163-9
- 2 Wiltse LL, Newman PH, McNab L. Classification of spondylolysis and spondylolisthesis. *Clin Orthop* 1976; 117:23-9
- 3 Roche MB, Rowe GG. The incidence of separate neural arch and coincident bone variations. *Anat Rec* 1951; 109:233-51
- 4 Rowe GG, Roche MB. The etiology of separate neural arch. *J Bone Joint Surg [Am]* 1953;35:102-10
- 5 Nathan H. Spondylolysis. Its anatomy and mechanism of development. *J Bone Joint Surg [Am]* 1959;41: 303-20
- 6 Gunzberg R, Wagner J. Degenerative spondylolisthesis with unilateral spondylolysis. *Int Orthop* 1988;12:139-41
- 7 Ravichandran G. Upper lumbar spondylolysis. *Int Orthop* 1981;5:31-5
- 8 Mathieson F, Simper LB, Seerup A. Multiple spondylolysis and spondylolisthesis. *Br J Radiol* 1984;57: 338-40
- 9 Nordström REA, Lahdenranta TV, Kaitila II, Laasonen EMI. Familial spondylolisthesis of the axis vertebra. *J Bone Joint Surg [Br]* 1986;68:704-6
- 10 Cox JM, Aspegren DD. Degenerative spondylolisthesis of C7 and L4 in same patient. *J Manipulative Physiol Ther* 1988;11:195-205
- 11 Currarino G. Primary spondylolysis of the axis vertebra (C2) in three children, including one with pyknodysostosis. *Pediatr Radiol* 1989;19:535-8
- 12 Willis TA. The separate neural arch. *J Bone Joint Surg [Am]* 1931;13:709-21
- 13 Waldron HA. Rates for the job. Measures of disease frequency in palaeopathology. *Int J Osteoarchaeology* 1991;1:17-25
- 14 Waldron HA. Prevalence and distribution of osteoarthritis in a population from Georgian and early Victorian London. *Ann Rheum Dis* 1990;(in press)

(Accepted 8 January 1991)